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CHAPTER FIVE

The Software Industry in Egypt: What Role for Open Source?

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Open source software (OSS) is software whose underlying programming source code is freely available to users to access, modify, and redistribute under the same or less restrictive distribution terms. This may be contrasted with proprietary software where the copyright holder – individual or a company – sets restrictions on its use, copying and distribution. The terms of use for proprietary software are outlined in a licensing agreement that typically does not allow the free distribution of the software, nor the modification or inspection of its inner workings. OSS is the product of a long time movement toward software that is developed and improved by volunteers from all around the world collaborating together on a network. It offers a new form of knowledge production based on peer collaboration and community based innovation. OSS is also associated with knowledge liberalization as it provides accessible platforms of knowledge that do not commodify information by imposing barriers to its acquisition.

The objective of this chapter is to assess the current and potential impact of OSS on the access to and creation of knowledge, economic growth, and ultimately development in Egypt. At the heart of this work is the belief in the power of knowledge creation in promoting human development, and the viability of business models based on platforms created by peer collaborative production in creating economic growth. In Egypt, a potentially strong base

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of human capital makes a fertile territory for the software industry to flourish in general. OSS in particular is at a nucleatic stage, which can be developed into an overall organized platform, provided the ecosystem incubating it facilitates this growth.

In this chapter we analyze OSS within the overall software industry in Egypt, and examine whether and the extent to which OSS might contribute to access to knowledge (A2K). Through a careful analysis of the existing ecosystem for the software industry in Egypt and a series of in-depth interviews with different stakeholders, we give a picture of the OSS landscape in the country, highlighting the variety of business models that companies are adopting. We also examine the barriers identified during the fieldwork, and which stand against the flourishing of OSS in Egypt. Finally, we present suggestions and alternatives for an improved ecosystem that would best enable the use of OSS to promote access to knowledge in Egypt.

OSS as paradigm shift

OSS is a paradigm shift in the software business. This is because it changes some of the fundamental assumptions about software products such as intellectual property right (IPR) protection. The mainstream IPR-based model depends on the premise that innovators, namely implementers and producers of software products, will be able to create a form of artificial scarcity by controlling the production of their software via the legal framework of a maximalist intellectual property regime. Perhaps the ultimate example of the success of this model presents itself in off-the-shelf products (e.g., Microsoft's office product suite). This business model allows software companies to recoup the costs of development by collecting payment for the same product from a large number of users. Overall, however, this business strategy has drawbacks for the state of competition and for society as a whole. Such a model creates a system that obeys the law of increasing returns. That is, clients will tend to gravitate toward the leader in a given product category and move away from other producers (Roeding et al. 1999). This suggests a high barrier to entry for newcomers; such an environment would not be optimal for a new and budding software industry that is unlikely to be able to compete against well-established companies (*ibid.*).

On the other hand, OSS presents an alternative business model, one that depends more on identifying the differentiating factors for companies, and

collaborating on the non-differentiating ones.¹ This may be appreciated if we think of software as a system made up of a number of components, some of which are necessary but non-differentiating, while others contain the innovative work and are differentiating in nature. Indeed, Perens argued that “90 percent of the software in any business is non-differentiating. Much of it is referred to as infrastructure, the base upon which differentiating technology is built” (Perens 2005). The essentially generic nature of non-differentiating technologies implies a benefit in collaboration as per open source models, and a waste in duplication as in proprietary models. Within the proprietary model of software development, competitors must each maintain the entire working systems as one closed unit. Each of the competitors would typically work separately to create their own version of the non-differentiating components within their final product. This is redundant and results in higher overall cost for the companies and their clients.

OSS then, becomes a wise choice for pushing down the total cost of ownership (TCO) of the technology infrastructure, which is the non-differentiating factors, such as servers, operating systems, databases, etc. This is especially relevant for countries where labor costs are low, as in Egypt, where TCO would otherwise be dominated by paying a license fee for the proprietary software (Weerawarana and Weeratunge 2004). OSS as an alternative model and a paradigm shift can help redefine the business environment in a manner that is more advantageous for budding industries. This may be more relevant for developing countries, as it may be best to build on knowledge that is already accessible through an open source platform and take that as a starting point.

Advantages of OSS accrue to different parties, from software developers, to service providers, to users. For example, software vendors can benefit from previously developed components and save the time and effort of redevelopment; service providers, such as web hosting companies, can benefit from existing OSS software to deliver services to their clients while saving on licensing fees; and users may use software freely and benefit from cost saving and community support.

1 Differentiating factors represent the strengths and innovative contributions of technology producers and may transcend both hardware and software. For example, IBM may consider collaborating with competitors on the development of an operating system, such as Linux, because the operating system is non-differentiating from its point of view. Pursuing this collaborative strategy enables IBM to unify its heterogeneous platform and sell more hardware in the process – its differentiating factor. Similarly, a database company, such as Oracle, might find that an operating system is non-differentiating while the database engine itself constitutes its main business (Valdurez, 2002).

Because of these advantages, the new paradigm offered by OSS has also become a reality that has imposed itself on the world arena. Over the past decade, OSS has expanded to overtake the web server market.² Apache has been the leader in the web server market since the 1990s and already dominates 71.94% of the market in 2009 (IDC 2008b). On average, Microsoft has had a steady growth rate in the web server market, which may indicate that Apache has been eating up the shares of web servers other than Microsoft. The market for Linux servers has grown at an annual rate of 11.8%, which exceeds the 9.8% growth rates in markets for Microsoft servers (ibid.). According to International Data Corporation (IDC), the worldwide generated revenue from “standalone” OSS was \$1.8 billion in 2006, and the expected growth rate from 2006 to 2011 is 26%, with revenues expected to reach \$5.8 billion in 2011 (IDC 2007).

While desktop and office software, which is closely associated with software in public perception, is one area where proprietary solutions continue to dominate, OSS has also been successful in a variety of other areas. Examples include web browsers such as FireFox, used to surf the Internet; email clients such as Thunderbird; productivity applications such as OpenOffice; telephony systems such as Asterisk. OSS has even found its way to mobile phones such as Google’s Android phone platform. FireFox gained a market share in 2008 of 4% on the expense of the proprietary browser Internet Explorer, which faced a decline of around 8% for the period from April 2008 to February 2009 (Net Applications 2009).

Conceptual framework

The software industry in Egypt sits at the heart of two related issues. The first has to do with the business structures within the software industry, given that it is a knowledge production industry. The second is concerned with software as an infant industry in developing countries, and the presence and type of protection that is accorded for the industry to flourish as a source of economic growth.

2 Web servers are systems that are used by content providers to deliver content to clients. They are special programs that typically run on dedicated machines which are able to respond to users’ requests made through web browsers and other clients. Web servers implement, among other things, the server side of the Hyper Text Transfer Protocol (HTTP) and its variants. Hence, web servers are among the most important software components, because the web is seen as the preferred platform for application delivery in many situations; it enables enterprises to save on client software update, maintenance, and deployment.

Production structures: vertical versus horizontal platforms

The recent developments in digital technologies have posed an interesting paradox in the economics of knowledge creation. On the one hand, the expansion of information and communication technology has facilitated the flow of information, a decline in barriers to market entry and exit, and the emergence of flatter production structures providing new opportunities for small players at the firm and country levels. The commonly viewed models of business process outsourcing and offshoring are cases in point. In many ways, the argument may be made that digital technologies are bringing economies closer to the textbook model of perfect competition.

On the other hand, as the unique cost structure for the creation of knowledge gives a strong potential for economies of scale and increasing returns to investments in knowledge, it can also lead to vertical production structures. These are monopolies that are built around the production of knowledge and knowledge-embedded goods. The private protection of intellectual property rights is a key factor in the emergence and sustainability of these monopolies.

To an economist, the above is a typical illustration of the argument that the digital economy is characterized by two concurrently opposing forces: one is the creation and spread of small firms and the other is the growth and expansion of larger structures. This is most accurately depicted by Martin Baily as “centrifugal” and “centripetal” forces of the new economy, where the impact of information technology on transaction costs changes the boundaries between firm and market, encouraging small firms (centrifugal) while simultaneously expanding mergers and acquisitions into larger structures (centripetal) (Baily 2000).

In the context of the software industry, we argue that similar opposing forces are at work. OSS provides a potential for small players to engage and proliferate. At the same time, intellectual property rights allow for larger conglomerates to grow around proprietary code. This provides interesting nuances in the interplay between intellectual property and competition. Maximalist IP protection will encourage and perpetuate large monopolistic structures built around knowledge creation; flexible IP regimes will enable the creation and spread of smaller firms. Therein lies the universal tension between intellectual property and competition.

This is highly relevant to software as it embodies the typical characteristics of a digital knowledge good: a reproducible knowledge output with high costs of production yet next to zero costs of reproduction. Given the wide scope of

networking and distribution allowed for by information and communication technology, this provides the potential for massive economies of scale, but also for loss of income through large-scale illegal copying that releases a perfect replica of the original. More interestingly, borrowing terminology from Yochai Benkler, software ranks high on three characteristics: “modularity,” “granularity” and “low cost integration” (Benkler 2002, 2006). In that sense, it is subject to extreme fragmentation and feasible division of collaborative labor, making it a strong candidate for peer collaborative production through a commons-based model (ibid.).

This new mode of production offered by OSS was presented in Ghosh (1998), Raymond (1999), and Tapscott and Williams (2006). While Raymond compared proprietary and OSS models respectively to a cathedral and a bazaar, Ghosh presented OSS production as a “cooking pot” for this information good - its non-rivalrous nature ensuring that there would be enough for everyone in the end. Tapscott and Williams presented OSS as an example of “mass collaboration” among contributors from all over the globe. Indeed, OSS is an illustration of a production “mode” which Paul Adler depicted as one that depends on communities cemented by trust (Adler 2001). He argued that for the production of knowledge, the community/trust combination is superior to both the market/price and the authority/hierarchy modes (ibid.).

The software industry thus provides the potential for horizontal platforms of peer collaboration around which flexible and innovative business models can be built. The very nature of software suggests the strong potential for the success of peer collaborative production, which is made easy by developing networks diffused by information and communication technology. As geographical boundaries become irrelevant, this provides a level field with new opportunities for contribution to knowledge from intellectual capital based in developing countries.

The infant industry argument in a new light

OSS also sits at the heart of a second major debate: whether a developing country can afford the growing pains of creating knowledge through smaller and younger production structures as opposed to relying on ready-made technologies that are imported from the developed world. This is highly relevant to the potential impact that OSS can have in developing countries, where a belief in this potential would necessitate attention on the part of governments to protect the infant industry. It is also a modified enactment of

the “infant industry” argument, where economists since the early nineteenth century have argued for protection through imposing import barriers in order to allow the local infant industry to eventually “grow up,” as it develops economies of scale free from the threat of competition from the advanced imports.³ Historically, this argument has been applied to heavy industries, typically the automobile industry.

Now the infant industry debate is no longer over physical industries that are products of the industrial revolution. Rather, it is a debate over protecting knowledge industries that are indeed much less tangible and that embody a unique cost structure of production, reproduction and distribution. Such a cost structure provides a strong potential for economies of scale in both proprietary and open source models. Yet this potential is captured by the larger proprietary firms whose products are in essence the outcome of imported knowledge. Effectively, OSS remains the infant domestic industry that needs protection. In this case, protection does not refer to blocking imports by imposing tariff barriers, but rather to shielding OSS firms by freeing them from the threat of market dominance by larger business structures, which is partly due to proprietary IPR protection.

The question becomes: to what extent is the growth potential of the infant open source-based companies constrained by unfair competition from the large proprietary software companies? Instead of protecting the infant industry by imposing import barriers as per the classical argument, we ask whether the present ecosystem of software industry in Egypt is protecting the aged proprietary firms by virtue of IP barriers? Is OSS production in Egypt, then, an infant exposed?

This issue fits into the developmental potential of OSS and the impact of domestic policies that work to “protect” it. In fact, Debroy and Morris (2004) argued that OSS by itself does not form the basis and roots for a local software industry that can compete globally. They acknowledge that open source business models built around the personalization and adaptation of the software to the needs of the companies may sustain profits that are enough to keep a few companies alive. They also recognized the advantages of OSS ranging from low cost, existence of local talent, and freedom from monopolizing Western software vendors. Yet they argued that different

3 This argument is most notably associated with Friedrich List in Germany in 1841 (supporting the protection of infant German industries from competition from English industries).

business models of open source are not economically sustainable since they are built on a service that can be very easily copied and imitated by any other company, and this lowers the price of the final product. Thus, they concluded that if the government chooses to support open source companies, it should aim at raising awareness about OSS and not foreclose all the usage of proprietary software. Companies can then choose the software that best suits their demands. This, in fact, does not depart much from our standpoint; namely, that a healthy ecosystem of a software industry should involve the diversity of both open source and proprietary models.

In contrast to this, a strong case for OSS for development is presented by the United Nations in the *Ecommerce and Development* report (UNCTAD 2003). The message of the study is that OSS promotes competition in a sector that was once out of reach, and has given developing countries the opportunity to develop their human capital and promote innovation and creativity. The report also included the argument that the cost advantage of OSS will increase the software diffusion in the country and that the money saved from paying for software licenses could be used to train people in software development. This will enhance the skill level of human capital in developing countries. Moreover, OSS adoption in developed countries may act as an incentive for developing countries to export OSS, and may also open opportunities for outsourcing (UNCTAD 2003). This is relevant to Egypt as it has recently been expanding as an outsourcing haven due to the diverse language skills of its young population, with increasing investments in outsourced activities, most notably in service industries from Europe.⁴

In line with this, Weerawarana and Weeratunge described the case for developing countries to adopt open source strategies as “compelling,” where the choice of OSS is not just “a mere product choice” (2004, 5). Rather, such choice should reflect “an alternative strategy for building, maintaining and changing the rules that govern information flows in the economy” (ibid.). These authors suggest that OSS will create value “through the key drivers of business opportunities, reduced investment cost and greater efficiency and to “effectiveness of government” (ibid.). They add that the actual implementation necessitates collaboration between the different players: government, universities, other educational institutions and private firms. In

4 In 2008 Egypt was awarded “Offshoring Destination of the Year” by the UK’s National Outsourcing Association. <http://www.noa.co.uk/index.php/awards/winners2008/>.

particular, they stressed localization, and argued that the success of an open source strategy will depend on the capacity of local industry to implement OSS as well as the traditional and other capacity building measures such as educational and training programs. They maintained the importance of targeting capacity building through developing new OSS products alongside other capacity building measures (Weerawarana and Weeratunge 2004).

A similar view is held by Weber (2000), whereby he attempted to identify the economic, social and legal structures which are behind the uniqueness of the OSS model. He examined the OSS development process in both micro and macro contexts. According to him, the study of OSS lies in three distinct sets of issues: the motivations, the economic structure of OSS development, and the social and political structures that organize, manage, and coordinate this complex process. Weber demonstrated that the OSS model succeeded in producing software that is widely used and trusted and hence should not be overlooked; this model, in fact, can be extended to other sectors of the economy, for it yields a new mode of production based on collective action rather than private investment (Weber 2000). In essence, that is a call for expanding horizontal business structures built around the creation of knowledge for the benefit of developing countries. This would also mean providing more room for “infant” OSS-based firms to expand away from possible market dominance by the larger establishments built around maximalist IP protection.

The promise of OSS for development was recognized by some developing countries whose governments took positive steps to encourage the industry. For example, Malaysia adopted an OSS master plan to promote the use of OSS in the public sector. The plan was launched in July 2004 as an outcome of a government decision, whereby an organizing body called the Open Source Competency Centre (OSCC) was formed and made responsible for the close guidance, coordination and monitoring of the adoption of OSS in the public sector. A clear strategy was devised with the plan divided into phases. Starting in 2004 with Phase 1 (called “awareness”), Malaysia moved on in 2007 to Phase 2 (“accelerated adoption”), expanding OSS adoption to all public sector bodies nationwide, in order to ultimately reach Phase 3 (“self-reliance”). The Malaysian vision to provide an enabling environment to OSS is evident in the following statement by the OSCC: “[A] full ecosystem to allow natural growth of demand and supply in OSS is targeted to be achieved in order to move forward to Phase III – Self Reliance in the near future” (OSCC 2009).

In other countries, there have been efforts at encouraging OSS adoption by the government. In Vietnam, the Ministry of Information Technology has issued instructions to government agencies and their clients to use OSS and train their personnel accordingly; computer traders have been requested to sell personal computers installed with open source and not “cracked” software (Vietnam Net Bridge 2009). In India, six local governments have adopted OSS in several fields such as education, e-government, and food and civil supplies departments (MCIT, 2009). At the national level, India’s ruling party agreed to adopt a “hands-off” policy in choosing between OSS and proprietary software, leaving the decision to individual government agencies (Ribeiro 2009).

Where Egypt stands in these debates

As stated above, the software industry in Egypt sits at the heart of the above two issues. While vertical models of proprietary knowledge creation perpetuate monopoly structures, flatter horizontal models of knowledge creation involve a pool of creators and tend to give rise to smaller firms. These would require an enabling environment where these firms are shielded from market threats originating from the larger, older market players. This has important implications for policy debate on how best to promote the Egyptian software sector, including OSS as an infant industry.

In Egypt, there is very limited scholarship on the software industry; most of the literature may be found in a few consultancy reports (AmCham 2007, IDC 2008a, 2008b). Apart from a few news editorials (Al-Ahram 2004 Schewe 2005), there is nothing written specifically on OSS in the country. An earlier study of the Egyptian software industry by Rizk (2002) examined the potential of the industry to take Egypt into the “New Economy.” The study offered a preliminary review of the industry’s performance trends, strengths and weaknesses. It concluded that Egypt possessed a potential comparative advantage for software development, most notably in the low-cost and well educated pool of human resources. However, the country lacked hands-on training and offers a labor supply to a market that is restricted by managerial and organizational imperfections, most notably in the heavy bureaucracy, in addition to the lack of access to credit and venture capital. The paper included an examination of the economic effects of the industry, arguing that achievements then fell short of the expectations set by the government at that stage. Given that the industry was then at an even earlier stage of development, there was no coverage of any existing or potential presence of OSS.

Perhaps this absence of literature on OSS in Egypt reflects a certain lack of belief that open source can expand and compete given Egypt's environment that is highly dominated by proprietary software. At present, and with the growing belief worldwide in the role of OSS in promoting economic development, it is important to see how Egypt's software industry will evolve in the coming years. It is from this background that we move to explore the incidence and impact of OSS within the ecosystem of Egypt's software industry. We consider this within a broader techno-economic conceptual framework concerned with market structures and with growth potentials for developing countries.

The Egyptian software industry landscape

The software industry has been hailed as a potential engine for Egypt's economic growth. This is partly attributed to Egypt's human capital, given a tradition of a free system of university education where engineering schools graduate thousands of young Egyptian men and women every year. Given that the country has a population of more than 75 million people, 60% of whom are less than 25 years old, Egypt is argued, often by the government, to embody a strong potential for human capital in the software industry. Public policymaking involved in the Information and Communication Technology (ICT) sector has always emphasized Egypt's position as a potential leader in the software industry for the Arab region.

In fact, Egypt has historically assumed the role of a cultural leader in the region, and has been considered an especially strong center of potential creativity in the Arab software market. In particular, the government continuously announces its support for the software industry, albeit not once mentioning OSS. It is therefore important to note which model best suits Egypt's peculiarities and maximizes A2K.

Market structure

There are no published figures on the size of Egypt's software market. The only published figure is an IDC estimate of \$131.95 million as the size of Egypt's packaged software market in 2005. This is considered to be the highest ratio of software to total IT market size in the Middle East. Projections for the domestic market are relatively modest, expected to reach \$231.68 million in 2010 (AmCham 2007). Within that, the share of Linux-based systems is a modest 1-2% of Egypt's software market

(AmCham 2007, Interviewees). A few Linux-based systems are sold to the Egyptian government, which has close ties with the major proprietary vendor (AmCham 2007).

According to the Business Software Alliance figures, piracy rates for Egypt are high, estimated at 59% in 2008, which is lower than 2003's figure of 69% (IIPA 2009). We have three estimates for Egypt's software exports: a government-announced figure of \$500 million in 2006, an IDC estimate of \$145 million in 2005⁵ and an American Chamber estimate of \$70-90 million for 2005 based on an earlier study by AT Kearney. Despite the variation in the figures, there is an agreement within all three sources on the strong potential for export and outsourcing by Egypt's software firms (AmCham 2007).

The third source offers some detail on the companies as the estimate is based on a 2006 American Chamber of Commerce survey of major software companies.⁶ The total exports of these companies were estimated at around \$66 million projected to reach \$250 million by the end of 2008. The bulk of the exports of these companies was directed toward North America (more than 40%), the rest going toward the Middle East (28%), Europe (19%) and Africa (8.3%). The share of North America was expected to reach 50% by the end of 2008 (AmCham 2007). To our knowledge, there are no updated sources to confirm whether this target has been achieved.

The Egyptian software sector is mostly focused on customizing existing software for specific businesses (e.g. providing the service of customizing banking or human resource applications). Egypt's comparative advantage lies in labor-intensive services as opposed to "one-time products" (AmCham 2007). This is consistent with the apparent global trend within the software industry to become more service oriented. Cusumano (2008) suggested that the move toward service oriented work is "related to lagging growth in product sales and total sales, as well as the recession that followed the Internet boom." This, in fact, provides an argument in favor of adopting OSS platforms, given the lower cost of ownership and lower barriers to entry as well as their apparent suitability for service oriented models. This is particularly relevant to services related to end-user products such as word processors, since such

5 This figure of \$145 million is divided as follows: IT products (\$15m), content (\$30m), localization (\$15 m) and IT services (\$85m) in 2005.

6 List of 23 companies, mostly proprietary with the exception of open craft, IBM, Oracle, Cisco, ITworx and SysDsoft.

products/markets seem to follow the law of increasing returns. OSS offers a great equalizer for those who want to develop differentiator products that may be commercialized as add-ons to existing end-user products. For example, a company that wanted to market a product enabling Arabic handwriting recognition would have a much easier time integrating its offering with the OSS OpenOffice than with the proprietary Microsoft Word.

Looking to the future, the largest share of Egypt's projected exports is expected to come from offshore development activities. This would be the outcome of centers created at large multinationals (IBM's Technology Development Center and Microsoft's new Innovation Center) as well as software outsourcing by companies like ITWorx and Harf. Call centers are expected to be the next biggest, followed by professional services and content. IT services and Arabic content are predicted to be the fastest growing sectors, with a compounded annual growth rate through 2010 of 27% and 46% respectively (AmCham 2007).

The Middle East market offers a strong potential for Egypt's software industry, especially with Arabization and the increasing interest in Islamic content. This is a public policy interest and one of the priorities of Egypt's Ministry of Communication and Information Technology; a discussion of the government's efforts in the field of Digital Arabic Content is presented by Sherif Kamel in his chapter in this volume. Meanwhile, large companies like Google and Microsoft have started to capture this opportunity. According to the American Chamber of Commerce report, Google released most of its products in Arabized versions, and Microsoft has expanded its Arabic offerings "dramatically", which included the launch of a technical support site for Microsoft Office that is fully Arabized. Smaller companies too, like Harf have specialized in Islamic content and developed Islamic calendars, prayer time calculators and interactive Qurans (AmCham 2007).

Profiles of software business models in Egypt

This section outlines the main classes of software related industry sectors that are within the scope of our study. The classification builds on the work presented in Roeding et al. (1999), and reflects commonly accepted industry norms, but has been customized to address the current Egyptian software industry and its relation to the open source movement. The main classes addressed are: 1) software resellers and support providers; 2) producers of their own intellectual property; 3) software service providers; 4) IT and Business

consulting firms; and 5) other IT service providers. We argue that each of these classes of businesses may potentially benefit from greater adoption of OSS products, although in different ways in addition to lowering the total cost of ownership, which is a common advantage across all business models.

Software resellers and support providers (Business Model 1)

Businesses in the first category typically act as agents or resellers to other software vendors. Common examples include companies acting as agents for off-the-shelf software products, such as Microsoft Office or Adobe Photoshop, or Red Hat in the case of OSS companies.⁷ In such cases companies typically offer license and installation media sales services; in many cases they also act as the first line of support for the products they sell. The resale aspect requires a minimal amount of technical knowledge as it is essentially a form of goods moving. A standalone reseller model is typically based on off-the-shelf software products (such as productivity tools).

For software systems that are typically classified as enterprise solutions, such as Oracle financials and SAP Enterprise Resource Planning solutions, the support aspect of such business can range from simple assistance with the basic use of the software to sophisticated consulting and customization. The consulting side of this business is very rewarding as estimates suggest that 70% of the cost of such projects would be directed toward consulting and high quality services. Much of the consulting and customization work is typically directed to business aspects of the solution rather than the pure technical ones (e.g. to follow a legally mandated work process or produce a report in a specific format). This suggests that a large portion of the needed expertise is solution-independent. In turn, this suggests that if a localized open source product proves itself to be of high quality then this would attract system integrators wanting to bring down project costs while at the same time delivering high-quality services to their clients.

With the exception of very few solution independent companies,⁸ most establishments currently in this category in Egypt are linked to proprietary

7 Linux Plus is a company that describes itself as a "Red Hat Advanced Partner" providing a number of reselling, training, and consulting services centered around Linux-based technologies from Redhat, Oracle and others (<http://www.linux-plus.com/>).

8 One such company is Valuesys, which, according to its official website, specializes in enterprise resource planning (ERP) in addition to IT infrastructure and security. It acts as a reseller of solutions including some open source ones, such as SUSE Linux. It also provides training, consulting and technical support services for a mix of open and closed source products (www.valuesys.net).

software producers (such as Microsoft and Oracle) and typically can only expect to gain low margins in return for their sales effort. Furthermore, such companies usually have to adhere to the business standards, practices and training guidelines of the software producer that may not be the best match for the local standards, culture and business practices. This can often create a lock-in situation for both the company and its clients.

In Egypt, software resellers and support providers range from tiny outfits of 10 people or fewer to larger players, an example of which are multinational giants such as IBM, and large local system integrators, such as RAYA. RAYA is one of the successful systems integrators in Egypt. Its line of business ranges from retail (e.g. mobile phones and personal computers) to specialized software development. The range of expertise within RAYA is quite diverse and includes sales, technical and business skills. We therefore suggest that companies such as RAYA stand to gain from the use and application of OSS. Essentially, OSS would allow them to leverage their business and technical skills to provide services to their clients without necessarily having to pay licensing fees to their suppliers.

We suggest that companies that do not have in-depth skills and depend mostly on reselling will probably not benefit much from OSS. However, Those which have the skills and depend on support and consulting, however, stand to gain from OSS. The second group can lower the total cost of ownership for their clients while maintaining better margins for their company.

Producers that own IPR (Business Model 2)

In this subsection we examine companies that produce their own product, which may be classified under one of the known intellectual property forms, either copyright or patents. For the purpose of this discussion we have identified the following subcategories: 1) producers of standardized business products; 2) R&D-based products; and 3) embedded systems producers.

Standardized business products

Such firms typically produce their own software and sell licenses and support services to their clients. These include typical business applications, such as accounting applications, and vertical market applications, including hospital or hotel management systems. Such applications would be copyrighted and the companies would possess trademarks, but they would rarely hold patents. This is because the knowledge value added within such applications typically

does not include enough novelty to warrant a patent. The more standardized the products are – meaning the more likely they are to become off-the-shelf – the more competitive the market becomes (see Roeding et al. 1999).

A notable alternative example is OpenCraft.⁹ This successful software company specializes in developing, maintaining and supporting open source systems for small and medium-size organizations. It reports that its revenues flow from customization of OSS, implementation and integration activities, and training, support and maintenance. It specializes in four important areas of enterprise computing, namely: customer relations management (CRM) systems; document management systems (DMS); content management systems (CMS) and Internet applications. The success of OpenCraft presents a good argument for the OSS model: it delivers value to its clients while minimizing the total cost of ownership because it depends on OSS building blocks. OpenCraft has attracted Egyptian investment giant EFG-Hermes, which now owns 40% of the company (Mardini interview 2007).

One would argue that such products will eventually follow the law of increasing returns. As such applications become more standardized and multinational companies continue to provide localized versions on their products, the top products will be the only ones to survive (as proprietary ones). Other firms that have not become the top players would/should move away from selling the products toward selling support and consulting services. This would enable them to leverage their business and technical knowledge. A move toward OSS would be beneficial for such firms as it would help reduce the total cost of ownership to their clients and potentially help the OSS firm gain more business. From the client's perspective, the actual product used is likely a non-differentiating factor (see Perens 2005), while the ability to perform the business task may well be so. That would suggest that clients, particularly in a price-sensitive market such as Egypt, would opt for the effective yet less expensive solution.

R&D-based products

These firms are able to produce unique products based on their own R&D and innovative work. In Egypt they work mostly on language-based Human Computer Interfaces (HCI). Such firms include RDI, Sakhr, IBM, ImagineIT, and others. For example, RDI is famous for the production of Arabic

9 The co-founder of OpenCraft, Abdelkarim Mardini, was interviewed extensively for this research.

voice-based systems (speech synthesis, recognition, and compressions) and has done some leading work in this area. Sakhr, in the meantime, is a leading producer of Arabic software and has done some pioneering work in Arabic language processing.

For companies in this group as possibly the unique owners of important technologies, it might be more advantageous to remain within the realms of traditional IP approaches as far as their innovations are concerned. Nevertheless, it could be beneficial for such firms to integrate their products with other OSS systems in order to reduce the total cost of ownership.

Embedded systems producers

These firms produce embedded applications that are either part of a larger system, such as industrial systems, systems controlling textile machines, or standalone devices, such as mobile phones, satellite receivers and others. They are sometimes characterized as hardware vendors since their products are often combined with hardware or industrial products. Such vendors tend to benefit from OSS because it lowers the cost of the non-differentiating elements in their products (Perens 2005). In general, vendors that provide combinations of software and hardware also benefit from OSS because it tends to reduce the overall product cost. One successful Egyptian company working in this field is Electronic Formations, which provides consultancy services by integrating, compiling and packing of software—both proprietary and open source. The firm has successfully developed and produced a Linux-based appliance for network security which is now used in many of Egypt's cyber-cafes.¹⁰ For such companies, depending on the type of system or application, the use of OSS will be beneficial as it will help lower the TCO for their clients.

Software service providers (Business Model 3)

These firms develop software for others.¹¹ Their business model is based on renting out their skills as software developers and consultants. Such firms typically charge their clients on the basis of man-days (labor/effort cost) and hand over

10 The Managing Director of Electronic Formations, Osama Abou Elsorour, is among our interviewees. According to the firm's website, "One of EF's strongest initiatives is the support for open source free software. By adapting such a class of software, businesses are able to deploy technologies that otherwise were unfeasible due to the high costs associated." About Electronic Formations, <http://www.eformations.net/site/docs/about.asp>, last accessed April 14, 2009.

11 An example of this model is offered by Phoenix Egypt, whose manager is among our interviewees.

the product to their clients who typically own the product IPR. These firms have no real stake in the produced IPR and often report that they work on whichever platform the client demands. They may save some costs on using OSS when it is non-differentiating. Some software firms have reported that they use OSS during the development phase of the software and then switch to the proprietary product at installation/deployment time (as required by their clients).

Such firms typically report that they are agnostic on the subject of OSS versus proprietary (e.g., ITWorx) since they typically do not own the end product. It should be noted, however, that adopting an OSS model may offer greater advantages to them. Such advantages may include the ability to reuse older work for a new client, thus improving the efficiency of their services, and it may enable them to move to different and more effective business models similar to producers that own their own IPR, as described above.

IT and business consulting firms (Business Model 4)

Such firms typically offer customization and consulting services for enterprise-level solutions. Examples might include SAP, Oracle financials, and similar systems. They leverage their IT and business knowledge to deliver such services.

On one side such firms may benefit from the brand names they represent. Most of their revenues are likely to stem from their business expertise and knowledge of local needs. Depending on which of the two factors is more important, the use of OSS might be better for such firms as it can lead to lower total cost of ownership (TCO) for their clients and greater margins for them. It should be noted that there is some overlap between such firms and software resellers and support providers described as Business Model 1 above. However, consulting firms tend to be smaller in size and to concentrate more on the customization and consultation aspect of the business. One may argue (based on the analysis found in Roeding et al. 1999) that consultation firms' success tends to be driven by their utilization of their resources. They also tend to be localized firms, either local firms or local branches of multinational consulting firms. Thus we should expect to see firms that are more inclined to promote OSS-based solutions when appropriate, as this would reduce the TCO for their clients.¹²

12 This prediction was borne out in an interview conducted with Mr. Abdelkarim Mardini of OpenCraft, who indicated that his company, which uses OSS technologies to provide software services and solutions, will be targeting new consultation clients in the coming period in order to raise their revenues.

IT service providers (Business Model 5)

Such firms include Internet Service Providers (ISPs) and Application Service Providers (ASPs). Typically such firms offer hosting services and lease access to their infrastructure which may include network resources, systems and applications.

Such firms stand to gain from using OSS-based systems to deliver their services. This would enable them to lower their operational costs because they would not need to pay hefty licensing fees to software vendors or have their hands tied by prohibitions on software modifications. The so-called “cloud” of Web 2.0 is mostly driven by OSS; for example, firms such as Google, Amazon, Yahoo, and others use OSS to run their services and infrastructure.

We suggest that local ISPs and ASPs will benefit from complementing their infrastructure with OSS. One example is TE-Data, which is one of the leading local ISPs and provides typical connectivity and hosting services to its clients. Management at TE-Data took a conscious decision to use open source tools as the basis of the firm’s service delivery. For example, it has used Linux as its main back-end operating system, qmail as its email server, and Apache as its main web hosting environment. This has allowed it greater operational flexibility and cost savings.

Perspectives from the field

In this section, we present fieldwork conducted with Egyptian companies belonging to the different classes outlined above. Here we build on a conceptual framework of OSS layers based on the literature on OSS motivation and human capital (Von Hippel and Von Krogh 2003, Perens 2005, Benkler 2006, Lerner and Tirole 2006 and 2006b) and what we have witnessed in the field. We start our fieldwork keeping in mind the premise that OSS is created through peer collaborative production that makes use of a global pool of human resources and that is cemented by trust. We consider this base to be the first layer of OSS creation, Layer 1: software developers and “techies.” Contributors to such forms are motivated by factors that extend beyond mere monetary appropriation, e.g. self-gratification and reputation building. The next layer in this process is the utilization – still by producers – of OSS for further production of a good or service or both. This takes place through business models that are motivated by the profit incentive,

forming Layer 2: entrepreneurs and businesses around OSS. Building upon this framework, we argue for the presence of a third important segment represented by individuals and businesses that make use of OSS for their own purposes, Layer 3: consumers of OSS. (See Figure 5.1 below.)

We map the multilayered human capital for OSS across the software business models prevailing in Egypt as described in the previous section. We single out OSS companies in Egypt and place them within the relevant business model and identify the layer of human capital associated with the respective companies. Most OSS business models in Egypt are placed in the second layer, namely entrepreneurs creating businesses around OSS. The arrows indicate an expansion to include another layer of human capital. In the case of Business Model 2 (producers that own IPRs), these companies started out as OSS techies who eventually started their own business around OSS (most notably OpenCraft and IT Synergy). In the case of Business Models 3-5, these are businesses built around OSS that if encouraged would spin off into high quality individual OSS developers and techies.

- In our analysis for Egypt, we consider the following:
1. To what extent are there in Egypt contributors to the creation of open source modules (Layer 1: software developers and techies)?
 2. What are the current practices/business models in the open source sector, and how do they compare with models adopted in other countries (Layer 2: entrepreneurs and businesses around OSS)?
 3. Do the current practices actually serve to maximize A2K in Egypt from the perspective of software users (Layer 3: consumers)?

Figure 5.1: OSS businesses within prevailing software business models in Egypt and across multilayers of OSS human capital

Human Capital Layer	Business model (BM)				
Layer3 Consumers of OSS	All 5 models can be present here since each one of them can be a user of OSS				
Layer2 Entrepreneurs and Businesses around OSS	BM 1		BM 3	BM 4	BM 5
Layer1 OSS developers and Techies		BM 2

4. For each layer, we ask the following questions:
 - a. What is the size of people/firms included in this layer?
 - b. Is using, programming or developing a business around OSS elitist in nature, in the sense that it requires and builds an elite class of technically savvy developers and users?
 - c. What are the requirements for creating calibers of OSS programmers/users?
 - d. What are the hindrances that stand in the way of creating such calibers (political, social, economic, legal, etc.)?
 - e. What, if any, are the contributions of OSS firms to the Egyptian society/economy and to A2K?

To answer these questions, we conducted a set of interviews with different stakeholders including OSS community (Layer 1), OSS companies (Layer 2), multinational software companies (proprietary and OSS users), academia and government, and civil society (included in Layer 3). Note that Layer 3 members are dispersed among different categories of interviewees. Informants were mostly chairmen, managing directors and marketing managers.¹³ They were asked about the OSS position in the Egyptian market, reasons for this position vis-à-vis proprietary software and chances for OSS to flourish. It is important to understand their responses as indicative keys to the industry's position in Egypt rather than as an exhaustive explanation of it.

There was a general consensus among the interviewees that the OSS movement in Egypt is in its infancy: the size, impact and role of OSS in Egypt are at best modest, if not marginal. The OSS community in Egypt includes about 500 people (mostly fitting the Layer 2 group), with a maximum of 50 people contributing proactively to global OSS development (Layer 1). OSS started in Egypt around 1999-2000, with the number of OSS companies now ranging between 11 and 30. The average number of employees in OSS companies ranges from 16-20 (Layer 2). Overall, the average age of members of the OS community varies from 16 to late 30s (survey questionnaire to interviewees).

Three major themes emerged in our interviews. The first is the potential benefits of OSS solutions for Egyptian businesses (Layer 2 capital), users

13 Companies interviewed may fit more than one business model; for example, IT Synergy and Open-Craft fit Business Models 2 and 3 above.

(Layer 3), and developers (Layer 1), as highlighted both by OSS vendors and users themselves. Despite these benefits, interviewees acknowledged that market share of OSS remains small. This observation brings up the second theme: the politics of market dominance by the larger proprietary vendors. Two main reasons emerged for this dominance. On the demand side, interviewees indicated that larger proprietary software companies are leveraging their market power to keep out smaller OSS competitors. On the supply side, interviewees noted that there is a human resources issue as well, as the necessary skill base for producing OSS may be lacking. This is the third theme emerging from the interviews: the paradox of OSS human capital, caught between constraints on labor supply and demand. These three themes are discussed in depth in the following sections.

The potential benefits of open source for Egyptian users

The most obvious benefit of OSS is that it is typically free. This is evident at the level of software for personal computers for end-users who are faced with one choice, either the expensive proprietary package or the illegally copied version. The price of the latest proprietary personal computer software sold legally on the market in Egypt is LE800 (equivalent to \$145).¹⁴ This is at a time when 97.5% of Egypt's population live below \$10 a day (World Bank 2007). This provides some context for the rate of software piracy in Egypt, reported as 59% by the International Intellectual Property Alliance, which represents the interests of IP-dependent businesses (IIPA 2009). It is fairly standard practice in Egypt to find illegally copied software bundled free of charge on the hard disks of personal computers sold on the market. While illegal, such practice does expand access to a knowledge good that is otherwise unaffordable to the layman in a developing country. OSS provides the legal alternative.

Despite that, price is not the only benefit, according to OSS industry insiders. Ensuring a competitive and high-quality service is another value added for the customer. Vincenzo Puliatti, Chairman of IT Synergy, a firm which provides OSS solutions, consultancy, training and support, explained: "The customer should understand that he is getting something more because with the closed source solution he is tied, forever." Providing open source solutions, argued Puliatti, "raises the bar for the quality standard,"

14 Market price in April 2009.

as OSS companies have an edge on price but also on quality, with an interest to retain the customer. Puliatti emphasized that OS business models are best suited to Egypt as a business environment. "Wealth is generated when you are building something new using the resources that were not exploited by somebody else. OSS by itself creates value added." He pinpointed the peculiar challenge for Egypt's use of OSS, saying, "OS has worked beautifully in a non-business environment, but the real challenge is how you can move this in a business environment" (Puliatti interview 2006).

From the perspective of the economy at large, OSS spares developing countries like Egypt leakages in the form of license payments made to foreign companies. Osama Abou Elsorour, Managing Director of Electronic Formations explained: "At least 70 to 80% of expenditures go to licenses and they don't even get injected back in the economy [in the case of proprietary software], thus all of this gets out of the country as royalties. This is like draining the amount of IT expenditure out of the economy. If it somehow gets recycled back it would make a lot of difference. Thus I saw a need in the market for alternatives" (Abou Elsorour interview 2007).

From a political perspective, OSS offers another element of comparative advantage over proprietary software, namely national security. In fact, a widely accepted security norm is that openness of systems makes them more trustworthy. This is because openness enables a more thorough review and scrutiny of the inner workings of such systems, which reduces the possibility of errors or trapdoors that might compromise security. One example is Borland's InterBase database application that allegedly had a back door, which is an illegal manipulation in the system that stayed for approximately six years and was only fixed after Borland released its product as open source in 2000 (Wheeler 2003). The importance of OSS for national security in Egypt was emphasized by more than one interviewee (Abou Elsorour, interview 2007, Tantawy interview 2007). "On the national level, national security is a major concern with the usage of proprietary software. OSS ensures a high level of national security," confirmed Abou Elsorour (Abou Elsorour interview, 2007).

Two OSS-using organizations interviewed are not involved in the IT sector at all, but are rather pure consumers of OSS, creating what we now call Layer 3. These parties on the customer end are not only using OSS to facilitate their business operation, but are actively promoting its use.

The case is manifest in the Arab Digital Expression Camp, a residential summer camp for children that aims to give them digital tools for self-expression and constant exploration of their identity through culture and heritage. The founders of this project made a conscious decision that the output of the children would be licensed under Creative Commons licenses. The children's contributions are put on archive.org and on an open blog in which they are stakeholders, but also where others can use and benefit from it. "We also want our curriculum to be open source, which anyone can use and teach elsewhere," the founders added (Shaath interview 2008, Yehia interview 2008).

The driving force of their concept is promoting collaborative work and information sharing at all levels of the camp, all of which are empowering tools of self-expression. The concept of using OSS as a catalyst for self-expression is meant to diffuse largely amongst different sectors of society since it encourages the participation of children from different backgrounds and various parts of the Arab World. Children learn "blogging, collaboration" as the program highlights "the power of a person in a community – completely individual yet part of a global community." Through deploying open source techniques, children get to learn that the Internet is "a network of people not a network of computers." Although open source solutions in certain areas like animation and multitracked offline editing are not yet optimal, the camp still uses them, since its mandate is to teach the children self-expression rather than filmmaking per se. This tendency is relevant given the emerging trend of independent cinema, low-budget productions and experimental filmmaking (Shaath interview 2008, Yehia interview 2008).

Sharing similar goals of OSS promotion, Da'm for Information Technology was established in 2006 with an aim to break information monopoly and difficulty of access, and to find parallels between information and ways to save it and share it. The means for this end is an attempt to provide information by depolarizing it and making it accessible from one side and breaking software monopoly by promoting the use of OSS from another side (Abdel Hamid interview 2007). With a mandate to service researchers of all kinds, Da'm has used Linux to start a portal dubbed *al-daftarkhana*, (literally translated as "the archive") where it digitizes, stores and classifies news stories and features from 45 different Arabic-speaking newspapers on a daily basis, providing one of the most elaborate news databases in

Egypt. In their mission statement, Ahmad Kheir and Khaled Abdel Hamid, the initiative's founders, wrote, "Da'm is an attempt to break the prevailing gloominess in the information world in Egypt, with the lack of a culture of information sharing and the lack of a law regulating it". Kheir and Abdel Hamid 2006. Their decision to use OSS exemplifies their commitment to use free and non-mainstream platforms of knowledge sharing, which is symbolic of their project's mission.

The previous two models of OSS use represent not only a shift from proprietary software to OSS for more suitable solutions, but a profound belief in OSS as a concept and tool conducive to information liberalization and access to an incumbent yet scattered body of knowledge in Egypt that is in dire need of digital dissemination. The nature and crux of their operations stand to benefit from their establishment of a wide access to knowledge, which can best be implemented through the use of OSS. The use of OSS maximizes an uncontrolled access to their products, which is the prime goal of their operation.

The politics of market dominance

To a great extent, the continued infancy of the OSS movement at this point has been attributed by our interviewees to market dominance by proprietary software in Egypt. The currents of centripetal forces mentioned earlier in this chapter are much more powerful than those of centrifugal forces on the scene of software production in Egypt. Indeed, the ecosystem of the software industry reflects the tension between the large proprietary corporations and smaller businesses built around OSS. This does not give much room for the infant OSS industry to grow. This is reminiscent of the argument made in the first chapter of this volume, namely that the negative impact of monopolies is more pronounced in the case of small developing countries, given the smaller size of their markets that are already dominated by "at most a limited number of firms" (Stiglitz 2006, 119). This renders the costs of privatizing knowledge greater and the benefits smaller in the case of developing countries (ibid.)

The economic dimension of this market control has been intertwined with evolving politics that ended up fostering this control. Abou Elsorour, from Electronic Formations, expounded on the reasons behind this scenario:

For the big players, a market like that of Egypt is very easy to shape, and to direct as they want. [It is also] very easy to strike deals with the government because when the government depends on one major proprietary vendor they spend millions of dollars worth of licenses every year so they can lobby them to do anything, which is what happens. (Abou Elsorour interview 2007)

Abou Elsorour had asked about the possibility of using OSS in the "Computer for every home" initiative, a government-supported scheme to provide computers with a downsized version of proprietary software at LE1500 (equivalent to \$270).¹⁵ The response he got from people in charge indicated the difficulty of a shift to OSS, given how the major proprietary vendor is a main sponsor of this government initiative (*ibid.*).

Another main problem related to the growth of OSS in Egypt is lack of awareness. This was experienced first hand by Tamer Zaki, Manager of Phoenix Egypt, a firm that provides training, maintenance, support and some application development on the open source Linux operating system. According to Zaki, 60% of the clients to whom the firm made demonstrations about their services had no idea what Linux is. "They did not accept the idea that there are other alternatives to the major proprietary vendor," he added (Zaki interview 2007).

For Ahmed Tantawy, technical director at IBM Middle East and North Africa, there is a psychology of need for the brand name; consumers do not place high value on free Linux and OSS as they equate price with value. "Most companies prefer big names and brands to use rather than Linux," added Tantawy. He explained that consumers go for the brand name in the belief that this will grant them support and ensure minimum risk (Tantawy interview 2007). In some respects, the limited use of OSS in Egypt may be interpreted as a story of standard consumer preference (or bias) for reasons that have to do with compatibility, accessibility, awareness, and usability.

A political aspect of this dynamic was highlighted by Zaki, from Phoenix Egypt, whereby larger proprietary software conglomerates are able to leverage their market-dominant position to lower the potential for OSS market access. In the case of IT exhibits, market conglomerates participate

15 You can read more on this initiative in the chapter of this volume entitled "Information and Communications Technology for Development: Building the Knowledge Society in Egypt" by Sherif Kamel.

as partners and sponsors and are reluctant to accept the presence of an OSS company. Exhibit organizers may turn a blind eye to such practices in order not to lose the participation and partnership of the conglomerate (Zaki interview 2007). As a result, the OSS operations suffer and remain in the shadows of the big firms, where unfair hampering of potential competition decreases market awareness of OSS.

Market dominance becomes particularly critical when it is based on agreements with the government, which is still a main player in the market. For example, the major proprietary conglomerate helped the government boost ICT indicators through charging them a flat annual rate for services that include the provision of operating system software for computers in government offices and universities, contracting also to return part of the sales revenue to support programs in e-government and training. The rate is charged irrespective of the volume of sales, which offers a huge potential for disseminating proprietary software and eventually leads to curbing potential competition from OSS firms. These aggressive sales tactics create difficulty for OSS competition to remain active in the market (Mardini interview 2007). This could be one of the explanations for why the OSS operation is still lagging in Egypt, as OSS firms are not allocated a significant market share. The issue becomes more of a competition law concern than an IP one.

The paradox of human capital

Placing the companies surveyed against the layer classification of OSS producers and users presented earlier in Figure 5.1, we find that the Egyptian companies that contribute to the open source systems are usually not the original creators or main contributors to such systems. Instead, it seems that those who contribute do so in more of a one-off fashion that is driven by direct client demand rather than long-term investment and planning. This is also embodied in their practice of delivering a customizable wide spectrum of products rather than specializing in a given area. This may be due to the fact that Egyptian firms are unable to commit to longer-term choices that imply taking the greater risks (and rewards) which specialization may bring. This in turn may be driven by the lack of risk taking partners (venture capitalists and the like) that are willing to participate in OSS-related projects in Egypt.

A requirement to fit the Layer 1 caliber of programmers in Egypt is to have some IT background. This alone may prove the hypothesis that an elitist group is required here, at least no less elitist than prospective developers

in proprietary firms. The primary reason for limited participation of this caliber in OSS development is the lack of awareness of this type of production, in part because the educational system's training programs overwhelmingly prepare developers for proprietary models (Mardini interview 2007). Yet this training focus itself reflects broader market conditions: the political influence of proprietary firms, the need of developers for a secure job and guaranteed income, and the limited personal initiative amidst harsh economic realities. "If you look at the demand in the market you will never find someone making a job posting demanding experience with open source, while you will find many asking for Oracle expertise, Microsoft, IBM experience," said Abou Elsorour from Electronic Formations (Abou Elsorour interview 2007).

But there is demand by OSS firms for qualified human capital. Puliatti from IT Synergy had the opportunity of hiring graduates from the Information Technology Institute (ITI), which had just graduated the first batch of graduates of open source geographical information systems (GIS). All seven were hired before they graduated. "There is a complete circle that we have to fulfill," explains Puliatti. On the one hand, it is not desirable to have too many graduates that will not be absorbed by the market, and on the other, there is an unfulfilled demand as companies "do not find the educational institution that can provide the type and level of education" they need (Puliatti interview 2006). The mismatch between supply and demand of labor for OSS firms is a hindrance to the expansion of OSS businesses in Egypt

In no instance was technology cited as the major obstacle hindering the modest yet growing trend for OSS. The reason the number of OSS developers is limited is the overall shortage of skills: poor quality of education, large number of graduates who are formally educated yet have no hands-on training and have never developed source code (Mardini interview, 2007). There is already a very small pool of those who measure up to international standards, e.g. contribute to projects on Sourceforge (Abdel Fattah interview 2007, Hassan interview 2007, Mardini interview 2007). Training in educational institutions is usually on conventional proprietary software. Awareness of the potential of this new model is very limited among users, developers and government officials. For these and the wider group of those involved in the OSS business trying to survive, pressure comes from the liaison between the government and the big players, in this case the large multinational and its service vendors.

Notwithstanding the above, technology does represent a hindrance in one way: it is the reason given by the government for not embracing open source. Namely, the argument is that Egypt is at an infancy stage with respect to ICT, and thus cannot afford experimenting with new technologies. In particular, the argument goes, there are not sufficient human skills to provide support for OSS in the Egyptian market, as compared with the available and competent technical support teams for proprietary software (Abdel Latif interview 2007, Adel interview 2007, Hashem interview 2007).

This statement brings out a paradox inherent in the OSS labor market in Egypt. On the one hand, the government does not encourage the adoption of OSS because of the lack of human skills to offer technical support for it. But this very lack of human skills is itself the product of a public education system that does not encourage OSS given the prevalence of proprietary software in university curricula and laboratories. It is not surprising that OSS firms expressed an unfulfilled demand and complained about the lack of OSS-qualified human capital in the market (Puliatti interview 2006, Mardini interview 2007).

The system of IT education is best described as “skewed” in favor of proprietary software (Mardini interview 2007). Mardini explained that Egyptian university curricula and laboratories (which are mostly government controlled and imposed) do not involve OSS adoption, training or development (*ibid.*). Although some of the OSS companies mentioned that they offer seminars about OSS in a number of universities, these seem to be rather limited in scale and scope. For universities, major vendors typically offer a bundle of software development tools at a low cost, which automatically translates into a reduced incentive to try out OSS alternatives (*ibid.*). This is expected, as noted above, given the government’s contract with the major proprietary software vendor to provide software for government bodies and national universities. In our context, this means a lack of sufficient room for OSS to grow, dooming it to remain an infant within Egypt’s software industry.

Human skills training within OSS companies is limited. Some companies provide training for the client’s employees, although it is generally basic training in usage of the software. If at all, intensive training is only given to the IT specialist in the company or network administrator. The current scope of employee training provided by the OSS companies does not suffice

to create skilled human capital capable of contributing to open source development, in terms of quality and quantity.

In the meantime, efforts at training and raising awareness seem to take place in a more grassroots, less institutionalized manner. Ahmad Mekkawy, team leader of system administration in E-Space, an Alexandria-based OSS developer, is an active member of a flourishing OSS community in Alexandria that started with no more than ten techies. The group has been touring different institutions to give awareness and training sessions about OSS. One of their activities has been a ten-day OSS intensive training at the faculty of engineering in the University of Alexandria, besides other training sessions conducted elsewhere such as at the Bibliotheca Alexandrina. Their website eglug.net serves as a platform for further community building and fostering ties and expansion (Mekkawy interview 2009).

The future

Interviewees' perception of the future of OSS is mixed. One interviewee spoke of a potential bright future for OSS in Egypt, in anticipation of the healthy maturing of the infant industry. According to Puliatti from IT Synergy, "There is and there will be potential for OSS in Egypt." Puliatti expects that in ten years, major proprietary vendors will be selling open source solutions. "They will not sell software per se, they will sell services, training, support, and they will give software for free" (Puliatti interview 2006).

Other parties interviewed predicted a more mixed future. With the lack of awareness among customers in Egypt, Abou Elsorour from Electronic Formations suggested the simultaneous use of proprietary and open source solutions is likely to continue. He has found that in some cases it was more beneficial for the client to have a combination of proprietary and open source, rather than focusing purely on open source. "You still end up saving money; you still end up profiting the economy, and providing the solution" (Abou Elsorour interview 2007). The mix of proprietary and open source services is also suggested by Tantawy from IBM, as it allows companies "to respond more comprehensively to all market needs." Tantawy explained that IBM started providing Linux-based solutions ten years ago in order to respond to the need of some customers for open source. "Although the investment cost of making any software work on two platforms is high, IBM continues to do so" (Tantawy interview 2007).

At the end of the day, the limited OSS operation in Egypt's software landscape is the outcome of limited demand and supply. On the one hand, there is a limited pool of qualified OSS human capital and venture capital to indulge in such risky and less known development. On the other, there is limited demand by the government and very little awareness on the part of consumers. This suggests, in our view, that the future of OSS in Egypt ultimately depends on strong government action to create greater space for open source and an enabling environment for a more competitive and dynamic software ecosystem. Policy reforms are needed, especially in the area of IT procurement as well as education and training. In the final part of this chapter, we review the conclusions that emerged from this research and identify specific recommendations to achieve this goal.

Conclusion

The fieldwork undertaken within this study sheds new light on the current reality of the Egyptian software ecosystem and the potential for OSS development. Our research reveals an OSS sector that is still in its infancy, but with strong potential to contribute to knowledge liberalization and economic growth in Egypt, if properly supported. Below we summarize the key findings of our research and specific policy recommendations.

Why OSS?

Based on our research, we argue that the existence of a healthy business sector based on OSS will have several advantages for Egypt as a developing country rich with Arabic content whose potential has not yet been realized in the digital world. Below we identify five benefits of a healthy OSS in Egypt from economic, technical, social and political standpoints.

First, OSS is perceived as a form of knowledge liberalization as opposed to knowledge protectionism and fragmentation. Its role in contribution to, and democratization of, knowledge through an innovative regulatory framework is instrumental. Highly relevant here is Eric Von Hippel's concept of "democratizing innovation," where democratizing "the opportunity to create is important beyond giving more users the ability to make exactly right products for themselves," and leads to radical and rapid improvement in users' ability to innovate (Von Hippel 2005, 13, 123).

Second, OSS encourages innovation and provision of training grounds for human capital. While both proprietary and open source involve costly

investment in human capital, investment in open source human capital “is not tied to a particular imported technology,” and hence “stays in the country” and contributes to its knowledge capital, whereas with proprietary software “you’ll never catch up, and you’ll have to pay forever, without ever learning anything yourself” (Linus Torvalds interview in Weerawarana and Weeratunge 2004). Accordingly, the “real advantage of open source ends up being able to build up your own knowledge base” (ibid.). Such a base would provide a critical mass of intellectual capital, which would boost an infant industry in a developing country rich in young human resources like Egypt.

Third, on grounds of economic efficiency, the presence of effective OSS companies would result in lower total cost of ownership (TCO) for much needed, but mostly non-differentiating, IT infrastructures. This would result in higher efficiency of businesses depending on IT (almost all mid-sized and larger companies in Egypt). In the absence of hefty licensing fees and training costs, the adoption of OSS models would create lower barriers to entry for IT firms that would leverage OSS to deliver services and new products. Moreover, the mere coexistence of open source models alongside proprietary ones encourages competition and market diversity, providing potential for the emergence and thriving of small players.

Fourth, on another level, OSS provides potential for localization, creating and enabling Arabic software, and offers opportunities for customizing applications to suit the local business culture. Such localization will be beneficial for local capacity building and establishing a knowledge base grounded in indigenous resources that address local needs.

Finally, the OSS model works within the existing IP system, and provides a flexible legal alternative to the mainstream which is associated with high rates of piracy. OSS offers an affordable legal alternative to the consumer in a developing country like Egypt. It also enables coders to earn a livelihood without requiring the already overstretched state to perform the role of software police.

Prospects for OSS in Egypt: potential and barriers

Although the emergence of a strong OSS sector would have several advantages from the Egyptian perspective, our research indicates that this sector is currently weak and will take time and effort to develop. There is hardly any presence in Egypt of a peer collaborative model of the type that provides

a wide platform for OSS as observed in Europe and in other advanced developing countries (Layer 1). There does, however, exist a nucleus for businesses to be created around OSS (Layer 2). These are struggling to survive against demand and supply constraints partly caused by political and market limitations. In other words, Egypt does not yet participate in the global OSS market as a major contributor of code, but does have an infant OSS industry composed of companies that gain from selling and customizing OSS to Egyptian clients.

Looking at the software industry as a whole, two parallel worlds exist. On the one hand, the old economy presides, with its strict proprietary rules, conventional market signals, firm hierarchy and authority, and a reality of high rates of software piracy. On the other hand, an alternative is offered by the rather limited, yet slowly growing, new trend of peer collaborative production represented by a small community of OSS developers (Layer 1). These form a subset of the total group of those owning or running companies involved in OSS production and distribution. This wider group also includes people who are merely involved in limited local Linux services and distribution (Layer 2).

The less optimistic, but perhaps more realistic, approach for Egypt would be to focus on encouraging Layer 2 small businesses created around OSS rather than hope to create the elitist human capital that will form Layer 1 of OSS contributors. This can be framed within the infant industry argument. Given the scarcity of Layer 1 caliber of OSS contributors, the limited awareness and the dominance of the major proprietary conglomerates, OSS will continue to be out of the mainstream. It is thus the case that Egypt is unlikely to have room to develop a strong OSS knowledge base of Layer 1 intellectual capital, on which are built the businesses developed by Layer 2 human capital. Rather, the country will have to rely on knowledge created elsewhere. It has two choices: either pay the high price tag placed on proprietary software, or build on freely available knowledge. Egypt should take the latter option, i.e. start businesses around OSS (Layer 2).

Based on our research, we find that the potential benefits of OSS discussed earlier have hardly been realized in Egypt. Such benefits can be realized, however, if there are conscious efforts by the government to provide an enabling environment that encourages the thriving of OSS businesses within a healthy ecosystem of software production in Egypt.

Economic efficiency through OSS-based companies in Egypt is feasible and strongly recommended. The expansion of shared non-differentiating platforms would expand domestic production, lower barriers to entry, and encourage competition and market diversity alongside proprietary models. In particular, this would allow the country to retain foreign currency that would otherwise have gone to pay for software royalties to multinational owners of intellectual property.

By reducing the cost of owning the tools, the use of OSS in Egypt eliminates barriers to accessing knowledge tools and helps contribute to original knowledge creation. As it stands, we find that there is much untapped potential for OSS to promote access to knowledge in Egypt, and this remains limited by political and other limitations discussed earlier in this chapter. While the use of pirated software remains widespread, controls are being enforced over time. This makes it more pressing to push for alternatives to the mainstream – be they OSS or other options offered by proprietary companies – as a healthy ecosystem for Egypt's software industry would also mean continuing to seek alternatives within available proprietary models.

Currently, however, the OSS world in Egypt is governed by a set of intricate political, sociocultural, economic and technical constraints. Of concern there is businesses' lack of readiness to switch to open source solutions. Given an already established platform built on proprietary models, an extra effort is needed to fight lock-in and bear the costs of switching to new open source models.

Additionally, the software market structure in Egypt reflects a competition issue. Dominance is supposedly curbed by the competition law that Egypt passed in 2005. However, the law has been very modestly enforced, resulting in only one court case with regards to a cartel in the cement industry. The law is therefore not working as a deterrent in an aggressive way that would prevent dominant players through fear of legal prosecution. Competition law implementation is still at its early stages, with underdeveloped institutional capabilities and limited application. In such an environment with limited regulation, dominant firms may leverage their market power to place themselves in a more favorable position with respect to the law than smaller firms. Within the opposing currents of the digital economy discussed earlier in this chapter, the forces toward establishing vertical production structures built around knowledge creation (centripetal forces) tend to overtake the opposite current toward smaller structures (centrifugal forces) in the case

of Egypt's software industry. Given this scenario, Egypt's OSS industry is indeed an infant exposed, and one that is unlikely to grow unless there is a conscious stance to proactively promote its demand and supply.

Recommendations for policy reform

In light of the above and at this stage, we conclude that a healthy ecosystem for an efficient software industry in Egypt should entail encouraging OSS-based businesses that are mostly focused on profit creation, and that would coexist alongside the current proprietary models. The spread of such OSS businesses would lead to creating a wider community of Layer 2 human capital and eventually give birth to communities of higher caliber OSS developers (Layer 1) as a spin-off. It will also allow for the growth of platforms for applications that promote human development through corporate and nonprofit uses (Layer 3).

To achieve this goal, the government has an important role to play, both on the supply and the demand side for OSS businesses. It is essential that domestic policies provide an enabling environment for OSS businesses to thrive, including a firm implementation of the competition law alongside offering business incentives to OSS companies, such as tax breaks and favorable utility pricing. Introducing OSS alongside proprietary software in educational curricula will help develop well-trained human capital that can be part of the OSS business sector (Layer 2) and individual developers (Layer 1), helping to relieve labor market bottlenecks. The government should utilize the thin yet strong body of OSS developers (Layer 1) in different endeavors, specially the ones concerned with direct knowledge production. This group can be perceived as a seed for OSS flourishing on many levels, especially with regards to curricular development and training in general. Overall, devising stronger links between OSS companies, universities and civil society initiatives will increase awareness and expand the use of open source by the community. The government can play a strong role as orchestrator of such synergies.

Moreover, for the OSS sector to flourish, the government should adjust its procurement policies to favor OSS, acting as a consumer to drive demand for open source solutions. Support may come in other forms as well, as where the government promotes OSS on an equal footing with proprietary software in trade shows, training programs, or initiatives such as the Computer for Every Home initiative. This may mean forfeiting some of the financial

incentives that proprietary software companies would offer in exchange for security of their market dominant role. The long-run benefits for Egypt of enabling OSS, however, will be substantial in both economic and non-economic terms.

On a final note, a belief in a role for OSS should be at the heart of a vision to expand the whole software industry as a driver for Egypt's development. This vision should be translated into a concrete strategy with clearly defined objectives and tools. The Malaysian model referred to earlier in this chapter is a good example. As a knowledge producing industry with the promise of positive externalities, economies of scale and building human capital, the software industry presents Egypt with an opportunity that should not be missed and a strong potential that should be maximized for promoting human development.

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